

REMARKS

Claims 1-17 and 21-40 remain in the application. Further examination and reconsideration of the application, as previously amended, is hereby requested.

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In Section 3 of the Office Action, the Examiner requested a new oath or declaration in compliance with 37 CFR 1.67(a). Applicants are submitting herewith a new declaration as requested.

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In Section 5 of the Office Action the Examiner provisionally rejected claims 1, 4-17, 21, 22, 24, 26-35, and 37-40 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over the claims 1-47 of co-pending Application No. 09/846,047 (atty docket # 10007763-1). In Section 6 of the Office Action, the Examiner provisionally rejected claims 2, 3, 23, 25, and 15 36 under the judicially created doctrine of obviousness-type double patenting in view of Negishi. Applicants are submitting herewith a terminal disclaimer in compliance with 37 CFR 1.321(c). Withdrawal of these rejections is respectfully requested.

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In Section 8 of the Office Action, the Examiner rejected claims 1-12 and 14 under 35 USC 103(a) as being unpatentable over Chuman in view of Hu. Applicants respectfully traverse this rejection. It is improper to combine Hu with Chuman as there is no objective reason to make this combination.

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Applicants believe the Examiner is incorrectly using Applicants' claimed invention as a template to combine the various elements found in the cited references. "In determining the propriety of the Patent Office case for obviousness in the first instance, it is necessary to ascertain whether or not the reference teachings would appear to be sufficient for one of ordinary skill in the relevant art having the references before him to make the proposed substitution, 30 combination, or other modification." In re Linder, 458 F.2d 1013, 173 USPQ 560, 562 (CCPA 1972). Further, as stated in MPEP 2141.02, the claimed invention 'as a whole' must be considered. If the insight of the inventors is contrary to the understandings and expectations of the art, the structure effectuating it would not

have been obvious to those skilled in the art. Further, the prior art must be considered in its entirety, including disclosures that teach away from the claims.

For example, one of ordinary skill would not look to Hu “to aid in improving the contact among components” as the Examiner is asserting. As discussed
5 below, this contention is partially because Hu teaches using his annealing process to “maintain a sharp profile” (col. 2, lines 35-37) of the emitter tip. As such, Hu is concerned with improving the contact between the metal Ir layer 34 and the semiconductor (Si) tip. On the other hand, Applicants are using their annealing process not to improve the mechanical contact (to increase hardness) but to
10 reduce the electrical resistance and to increase electron emissions.

MPEP 2143.01 states that the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. Also, a statement that modifications of the prior art to meet the claimed invention would have been “well
15 within the ordinary skill of the art at the time the claimed invention was made” because the references relied upon teach all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the references. Chuman does not disclose, teach, or suggest the desirability of
20 annealing his flat (not tip) emitter structure and one of ordinary skill would not look to Hu as Chuman does not have a sharp profile or a Si tip. Further, Hu discloses a field tip emitter (spindt emitter) and not an emitter having a “a tunneling layer disposed between the electron supply and the cathode layer” as Applicants are claiming. Therefore, Hu does not disclose or suggest the limitation “wherein the
25 electron supply, cathode layer, and tunneling layer have been subjected to an annealing process.” Although Hu does disclose subjecting its field tip emitter to an annealing process, its purpose is to form an alloy of the silicon and the cathode layer metal to form a metal-silicide layer which helps to maintain a sharp profile(see col. 3, lines 45-60 and col. 3 line 65 – col. 4, line 4). Since the
30 Applicants’ claimed invention has the “tunneling layer” between the “electron supply” (silicon) and the cathode layer (metal), a metal-silicide layer cannot be formed nor is there a need to maintain a sharp profile. Thus, there is no motivation to use the annealing step of forming a metal-silicide layer of Hu with a tunneling emitter of Chuman.

Applicants' insight of annealing a flat tunneling emitter to enhance electron emission is contrary to the understanding and expectations of Hu's annealing to create metal-silicide tips that maintain their sharpness. Indeed, it appears that the Examiner is using improper hindsight to pick limitations shown among the cited references to create Applicants' invention. Accordingly, the Examiner has failed to make a prima facie case of obviousness.

In the previous amendments, Applicants believe that they have demonstrated the non-obviousness of the claimed emitter and that the subjecting of the claimed emitter to an annealing process creates both statistically and significant practical results which were previously unknown to those skilled in the art and therefore not disclosed, taught, or suggested by the art made of record. Further, the Applicants have demonstrated that the physical structure of the product by process emitter is different from that of the cited art (in that the cathode layer has nanohole openings). Dependent claims 2-12 and 14 are believed patentable based at least on the patentability of claim 1 from which they depend directly or indirectly.

Accordingly, withdrawal of the rejection under 35 USC 103(a) for claims 1-12 and 14 and their allowance is respectfully requested.

In Section 9 of the Office Action, the Examiner rejected claims 13, 16, and 17 under 35 USC 103(a) as being unpatentable over Chuman in view of Hu and Xia. Applicants respectfully traverse this rejection for the reasons stated above for the combination of Chuman and Hu. In particular for claim 13, it includes the limitation "the emitter of claim 1 disposed on the substrate" and therefore incorporates the limitations of claim 1 and is at least patentable based on the patentability of claim 1 from which it depends. Claim 13 is believed separately patentable as well. Further with regard to claim 13, Xia does not disclose combining the circuitry for operating the emitter and the emitter itself within the same substrate to create an integrated circuit. Therefore, the Examiner has failed to make a prima facie case of obviousness. With regard to claims 16 and 17, Xia does disclose a display device but not one where the emitter and the circuitry for operating the emitter are combined within the same substrate. Withdrawal of the rejection under 35 USC 103(a) for claims 13, 16, and 17 and their allowance is respectfully requested.

In Section 10 of the Office Action, the Examiner rejected claim 15 under 35 USC 103(a) as being unpatentable over Chuman, in view of Hu, Xia, and Gibson. Applicants respectfully traverse this rejection for the reasons stated above for the combination of Chuman and Hu. In particular for claim 15, it includes the limitation "the emitter of claim 1 disposed on the substrate" from claim 14 on which it depends and therefore incorporates the limitations of claim 1 and is at least patentable based on the patentability of claim 1 from which it depends.

10 In Section 11 of the Office Action, the Examiner rejected claims 21-27 under 35 USC 103(a) as being unpatentable over Chuman, Moyer and Hu. Applicants respectfully traverse this rejection for the reasons stated previously for the rejection of claim 1 which further applies to the limitations in claim 21.

With respect to claim 22, Moyer does not disclose, teach, or suggest that the emitter is capable of emitting photons in addition to electron emission. Moyer instead teaches that the electron emitter emits electrons which strike cathodoluminescent material 22 which re-radiates energy as photons (col. 4, lines 17-31. Therefore, it is not the emitter that is emitting photons, as the Applicants are claiming, but a screen structure having cathodoluminescent material that emits the photons. Contrarily, because the Applicants have subjected the emitter to an annealing process that has changed the structure of the cathode surface to have nanohole structures, photons that are created by electron state transitions after tunneling are able to leave the emitter rather than being absorbed in the cathode layer as with conventional tunneling emitters.

25 Claim 24 is believed at least patentable based on the patentability of claim 21 from which it depends. As discussed previously for the rejection of claim 1 in this Office action, it is the annealing process that changes the structure of the emitter by creating nanohole openings in the cathode layer which allows for the higher electron density claimed by the Inventors. This annealing process is not disclosed, taught or suggested by the art made of record, including Hu. Hu discloses an annealing process that is used to create a silicide-metal layer. The Applicants' annealing process produces unexpected results which as shown provide emission current density at least one order of magnitude larger than that disclosed by previous art made of record for tunneling emitters. Such a current

density allows the claimed emitter to be substituted for field emission tips (spindt) emitters.

Withdrawal of the rejection under 35 USC 103(a) for claims 21-27 and their allowance is respectfully requested.

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In Section 12 of the Office Action, the Examiner rejected claims 28 and 31 and 33 under 35 USC 103(a) as being unpatentable over Chuman in view of Moyer, Hu, and Xia.

10 In regard to claim 28, the Examiner asserts that Chuman discloses "the emitter emits a visible light source (See Fig. 1)." Applicants respectfully traverse this assertion. Chuman does not disclose, teach, or suggest that the emitter is capable of emitting photons in addition to electron emission. Chuman instead teaches that the electron emitter emits electrons (e) which strike cathodoluminescent material 22 which re-radiates energy as photons (see col. 4, 15 lines 17-31. Therefore, it is not the emitter that is emitting photons, such as the Applicants are claiming, but a screen structure having cathodoluminescent material that emits the photons. It is because the Applicants have subjected the emitter to an annealing process that the structure of the cathode surface has changed to have nanohole structures, thereby allowing photons that are created 20 by electron state transitions after tunneling to leave the emitter rather than being absorbed in the cathode layer as with conventional tunneling emitters such as Chuman. Further, none of the references disclose "a lens for focusing the visible light source, wherein the lens is coated with a transparent conducting surface to capture electrons emitted from the emitter."

25 In regard to claim 31 and 33, claims 31 and 33 depend indirectly on claim 21 and are believed at least patentable based on the patentability of claim 21 as discussed above. Removal of the rejection under 35 USC 103(a) and allowance of claims 28, 31, and 33 are respectfully requested.

30 In Section 13 of the Office Action, the Examiner rejected claims 29 and 32 under 35 USC 103(a) as being unpatentable over Chuman, in view of Moyer, Hu, and Gibson. Applicants respectfully traverse this rejection. Claims 29 and 32 are dependent on claim 21 and include the limitations of claim 21. Therefore claims 29 and 32 are believed patentable based at least on the patentability of claim 21

from which they depend. Removal of the rejection under 35 USC 103(a) and allowance of claim 29 is respectfully requested.

5 In Section 14 of the Office Action, the Examiner rejected claim 30 under 35 USC 103(a) as being unpatentable over Chuman, in view of Moyer, Hu, and Suehiro. Claim 30 depends on claim 21 and is believe patentable based at least on the patentability of claim 21. Removal of the rejection under 35 USC 103(a) and allowance of claim 30 is respectfully requested.

10 In Section 15 of the Office Action, the Examiner rejected claims 38(Applicants believe the Examiner meant 34 and thus will proceed accordingly)-40 under 35 USC 103(a) as being unpatentable over Moyer in view of Hu, and Huang. Claim 34 had been amended previously to include the limitation "wherein the emitter has been subjected to an annealing process." As discussed
15 previously, none of the art cited or made of record discloses, teaches, or suggests the Applicants' claimed invention 'as a whole,' alone or in combination. Moyer is not a tunneling emitter and adding a tunneling layer within the opening does not disclose "a cathode layer disposed on the tunneling layer and portions of the conductive layer." In fact, Moyer teaches away from Applicants' claimed structure
20 because it discloses an emitter structure (see Fig. 4) of not having the cathode layer deposited in the opening in order to produce the non-uniform electric field. Hu discloses an annealing process to create a silicide-metal layer to maintain tip sharpness for a field emission tip emitter. A person of ordinary skill in the art by simply referring to the Moyer, Huang, Hu, and Chuman references would not be
25 able to objectively combine the references to create the overall structure of Applicants' claimed invention in claim 34. Nor would the person of ordinary skill be able to create an emitter that emits photons as Applicants are claiming in claim 40. Moyer discloses using an emitter to emit electrons which strikes a display that has cathodoluminescent material that then converts the electrons to photons.
30 Moyer does not disclose, teach, or suggest emitting photons as Applicants are claiming. By annealing the emitter, the structure changes, in particular the cathode layer forms nanoholes, such that photon emission and increased electron emission are possible.

Claim 35 is deemed patentable based on the patentability of its parent, claim 34, as amended. Further, claim 35 is believed separately patentable. The claimed emission is expressed in terms of current density per area. It would not be obvious to increase the emissions of Chuman, as one could not increase the current density per area by simply making the emitter larger. The Applicants have increased the emission current density by subjecting the emitter to an annealing process that changes the structure of the emitter, thus allowing for higher emissions. Indeed, Chuman shows in its Fig. 2 a maximizing of current density output of about 1×10^{-3} Amps/cm² by manipulating the tunneling layer thickness. The Applicants have been able to far exceed this current density by at least one order of magnitude (a factor of 10X) and indeed by even exceeding 2 orders of magnitude ("about 0.1 to about 1.0 Amps/cm²" as Applicants are claiming). In making the combination, the Examiner does not disclose how one skilled in the art would increase the current density nor does Simmons or Chuman disclose, teach, or suggest a current density greater than 1×10^{-3} Amps/cm². By using the annealing process and its ability to respectively alter the structure of the emitter by lowering the tunneling layer resistance, reducing ohmic contacts, and most importantly, creating nanohole openings in the cathode layer these unexpected results have been obtained. None of these changes in structure have been disclosed, taught, or suggested by the proposed combination. Further evidence of the state of the art in electron emission density is found in Kusunoki on page 1667 (bottom of left column) wherein the emission current to date (8/20/99 when manuscript received) is 50×10^{-6} Amps/cm². The desire for at least 1 mA/cm² is noted. In Fig. 5, Kusunoki only discloses an emission density of up to this 1mA/cm² limit, i.e. the same as Chuman. By annealing the emitter, Applicants have significantly and substantially outperformed other flat tunneling emitters created by prior art techniques thus allowing substitution for less reliable field emission tip emitters.

Claim 36 is believed patentable based at least on the patentability of its parent claim, claim 34.

Claims 37-39 are deemed patentable based at least on the patentability of their parent claim 34.

Accordingly, the rejection under 35 USC 103(a) and allowance for claims 34-40 is respectfully requested.

Applicants believe their claims as amended previously are patentable over the art of record, and that the amendments made previously were within the scope of a search properly conducted under the provisions of MPEP 904.02.

- 5 Accordingly, claims 1-17 and 21-40 are deemed to be in condition for allowance, and such allowance is respectfully requested.

Respectfully Submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Name: Chen, Zhizang et al

Date:

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Examiner:

Monica Lewis

Filed: April 30, 2001

Group Art Unit:

2822

PD No. 10007794-1

For: Annealed Tunnelling Emitter (as amended)

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Petitioner, Hewlett-Packard Company, is the owner of 100 percent interest in the instant application. Petitioner hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application, which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 to 156 and 173 as shortened by any terminal disclaimer of Application Serial No. 09/846,047 to Hewlett-Packard Company, the issue fee for which has not been paid, and is commonly owned by Applicant. Petitioner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the patent that is to issue on Application Serial No. 09/846,047 are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

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Please charge the required fee set forth in 37 CFR 1.20(d) of \$110.00 to Deposit Account 08-2025. At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account 08-2025 pursuant to 37 CFR 1.25. Additionally, please charge any fees to Deposit Account 08-2025 under 37 CFR 1.16 through 1.21, inclusive, and any other sections in Title 37 of the Code of Federal Regulations that may regulate fees.

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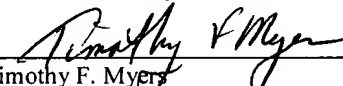
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I hereby certify that this correspondence is being deposited on 8/11/03, with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington DC 20231


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